A DESIGN OF WASTEWATER DISPOSAL SYSTEM FOR SMALL COMMUNITY

SITI JULIANA BINTI SAID

UNIVERSITI MALAYSIA SARAWAK

2002

Universiti Malaysia Sarawak
Kota Samarahan

fk

BORANG PENYERAHAN TESIS

Judul: ***A Design OF Wastewater Disposal System for Small Community***

SESI PENGAJIAN: 1999 - 2002

Saya **SITI JULIANA SAID**
(HURUF BESAR)

mengaku membenarkan tesis ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Hakmilik kertas projek adalah di bawah nama penulis melainkan penulisan sebagai projek bersama dan dibiayai oleh UNIMAS, hakmiliknya adalah kepunyaan UNIMAS.
2. Naskhah salinan di dalam bentuk kertas atau mikro hanya boleh dibuat dengan kebenaran bertulis daripada penulis.
3. Pusat Khidmat Maklumat Akademik, UNIMAS dibenarkan membuat salinan untuk pengajian mereka.
4. Kertas projek hanya boleh diterbitkan dengan kebenaran penulis. Bayaran royalti adalah mengikut kadar yang dipersetujui kelak.
5. * Saya membenarkan/tidak membenarkan Perpustakaan membuat salinan kertas projek ini sebagai bahan pertukaran di antara institusi pengajian tinggi.
6. ** Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan).
☐	TIDAK TERHAD	

(TANDATANGAN PENULIS)

Alamat tetap: Lot 20, Taman Seri Gaya,
Fasa 3, Lorong Seladang A,
Luyang 88300 KOTA KINABALU.

Tarikh: 14 JUN 2002

Disahkan oleh

(TANDATANGAN PENYELIA)

DR. LAW PUONG LING
(Nama Penyelia)

Tarikh:

CATATAN * **Potong yang tidak berkenaan.**
** **Jika Kertas Projek ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/ organisasi berkenaan dengan menyertakan sekali tempoh kertas projek. Ini perlu dikelaskan sebagai SULIT atau TERHAD.**

APPROVAL SHEET

This report entitled **"A DESIGN OF WASTEWATER DISPOSAL SYSTEM FOR SMALL COMMUNITY"** is prepared and submitted by Siti Juliana Binti Said in partial fulfilment of the requirement for the Bachelor of Engineering (Hons) is hereby partially accepted.

(DR.LAW PUONG LING) Date

Project Supervisor

A DESIGN OF WASTEWATER DISPOSAL SYSTEM FOR SMALL COMMUNITY

SITI JULIANA SAID

Tesis Dikemukakan Kepada
Fakulti Kejuruteraan Universiti Malaysia Sarawak
Sebagai Memenuhi Sebahagian Daripada Syarat
Penganugerahan Sarjana Muda Kejuruteraan
Dengan Kepujian (Kejuruteraan Sivil)
2002

I dedicate this project to my beloved family;
Daddy Said Bin Basman,
Mommy Joyita Hj Masri
and my siblings...

ACKNOWLEDGEMENT

First of all, I would like to thank God for giving me the strength to finish this final year project. Not forgotten, to my family and especially to my beloved parents for their kindness and encouragement.

My heartfelt thanks also go to my supervisor, Dr Law Puong Ling, for his guidance, advices and supports towards completion of this thesis.

Finally, special thanks to my colleagues and also to people who have helped me in making this thesis a great success.

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

LIST OF APPENDIXES

ABSTRACT

This thesis describes the design of a wastewater disposal system and subsequently to design soil absorption system which is used for wastewater disposal to provide important benefits for a community.

For the design purpose, the main source of wastewater is generated from commercial that is from a cafeteria specifically. The method to treat the wastewater is by using a septic tank and a leach field. Wastewater from the cafeteria flows into the septic tank. The septic tank removes some wastes but the septic tank effluent may still contain bacteria, viruses, chemicals and other contaminants. Thus, the leach field provides further treatment and absorption which it leaches through the soil.

Perforated pipes disperse the effluent throughout the leach field. Plants covering the leach field utilizes the water and nutrients to grow. Other than that, gas-venting system also should be provided in the design, which it capable of removing the odors gases to be safely vented to the atmosphere.

ABSTRAK

Tesis ini menerangkan rekabentuk kajian sistem rawatan air kumbahan dan merekabentuk sistem penyerapan tanah dimana ia digunakan untuk rawatan air kumbahan yang amat berguna untuk sesebuah komuniti.

Bagi rekabentuk ini, punca utama air kumbahan yang dijanakan adalah daripada komersial terutamanya kafeteria. Kaedah untuk merawat air kumbahan tersebut adalah dengan menggunakan tangki septik dan 'leach field'. Air kumbahan daripada cafeteria mengalir memasuki tangki septik. Tangki septik tersebut membuang sebahagian bahan buangan tetapi sebahagian lagi masih mengandungi bakteria, virus, bahan kimia dan bahan-bahan lain. Oleh itu, 'leach field' menyediakan rawatan yang lebih lanjut dan menyerapan dimana ia 'leach' melalui tanah.

Paip yang berlubang digunakan untuk menyebarkan bahan buangan ke seluruh 'leach field'. Tanaman yang menutupi 'leach field' memproses air dan nutrien untuk pertumbuhan. 'Gas-venting system' turut disediakan di dalam rekabentuk ini, dimana ia dapat membuang gas-gas berbahaya ke udara dengan selamat.

CHAPTER 1

INTRODUCTION

1.1 AN OVERVIEW

Wastewater is a liquid portion that comes from a community such as residences, institutions, commercials and industrials. It is a combination of liquid and carried wastes after the community has used it widely. This wastewater contains bacteria and viruses that can cause disease to human beings or other lives. Some may contain chemicals or toxic that presents in certain industrial wastes and can also cause disease such as cancer as well as death to living things.

Hence, the wastewater should be treated and disposed immediately to prevent not only the communities' health, but also pollution to the environment. After the wastewater is treated by some method of treatment, it may be disposed either to receiving waters or to the land. Treatment facilities and soil absorption system are the reason in conjunction of this design project objective, which can control and prevent the environment from pollution of untreated wastewater.

In this project, the sources of wastewaters that under investigation are those generated from commercial areas such as restaurant, cafeteria, dining hall and so on. Nevertheless,

the investigation is only focuses on wastewater from the cafeteria. Background and objectives of the design study will be discussed in this chapter.

1.2 BACKGROUND

In general, in sewered areas, a large septic tank has been used widely by small community such as cluster of homes. It acts as a collection system, which collects wastewater before discharged to the wastewater disposal treatment such as receiving waters like ponds and lakes. Meanwhile, buildings also are equipped with sewer system for the collection and transportation of wastewater. These communities may use pressure sewer system as a collection system before being discharged into a large septic tank and then pumped to a wastewater treatment plant.

In unsewered areas, wastewaters from small community are usually managed by onsite treatment and disposal systems. The most common type is intermittent sand filters for the partial treatment of the wastewater and disposal field or bed for final tratment. Thus, the challenge is to be able to provide the level of required treatment by designing a new wastewater disposal system for small community especially cafeteria.

In order to reduce the impacts on the environment, wastewaters from the cafeteria need to be pre-treated or treated by a suitable system that consist(s) of 2 major components:

i) a septic tank to remove solids and greases, and

ii) a leach field used for wastewater disposal.

In addition to design a new wastewater disposal system for this project, a grease tank should be provided and taken into consideration. This additional component (grease tank) would further enhance the traditional treatment system. Grease tank may trap greases and free oils that are loaded in the wastewaters from cafeteria.

Treatment by grease and septic tank should be provided to fulfill the required standards of treated wastewater before being discharged to the leach field that acts as the soil absorption system. A schematic diagram of a proposed wastewater disposal system for a cafeteria is illustrated in **Figure 1.1**.

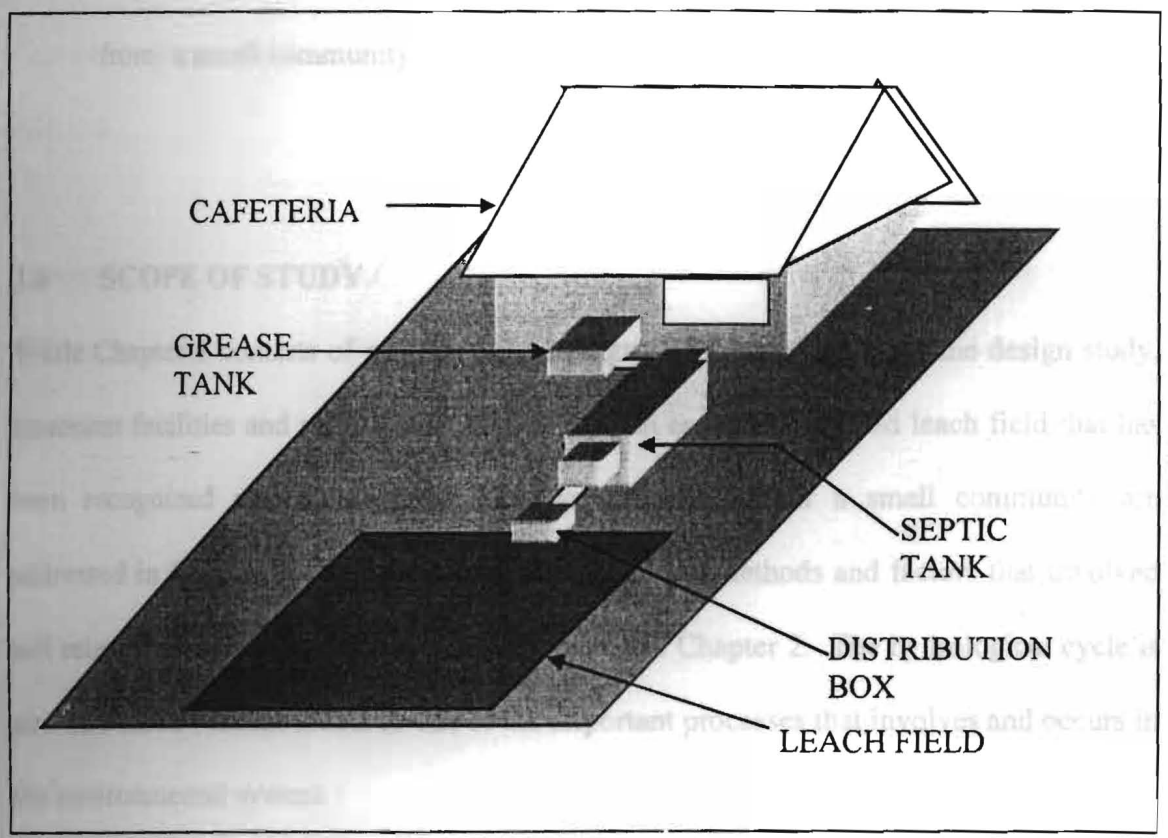


Figure 1.1 Proposed wastewater disposal system for a cafeteria

In this design project, wastewaters from the cafeteria are generated through the use of kitchen sink, garbage disposal and dishwashers. The average capacity of a typical cafeteria is about 200 persons per day. The determination of flowrates and wastewater characteristics will be discussed in Chapter 3. The characteristics are essential for the effective design of wastewater disposal system.

1.3 OBJECTIVE

The objective of this project is:

- to propose and design a leach system for the disposal of wastewaters generated from a small community such as *cafeteria.*

1.4 SCOPE OF STUDY

While Chapter 1 consists of providing the background and objectives of the design study, treatment facilities and soil absorption system such as septic tank and leach field that has been recognized as a solution of wastewater treatment for a small community are addressed in Chapter 2. Additional discussion such as methods and factors that involved and related to the design study are also addressed in Chapter 2. The hydrological cycle is also addressed because it acts as one of the important processes that involves and occurs in the environmental system.

The design of this study is included in Chapter 3 consisting of the design of the modified wastewater disposal system. Alternative treatment facilities such as grease tank and gas-venting system as well as the determination of wastewater flowrates are to be developed and given special attention. Grease tank would be installed before the septic tank. Dimensions of the treatment system are provided as a guideline to designing engineers. Suitable plants help to treat the wastewater that has been distributed by the perforated pipes over the leach field.

Results and discussions of the design study are addressed in Chapter 4. This chapter includes the analyses and discussions about the modification of design of wastewater disposal system, which acts as an alternative system to treat the wastewater from the cafeteria.

Chapter 5 concludes the design of the project. The wastewater flowrates are to be 15 gallons per capita per day (15 gal/capita.d) (Tchobanoglous and Burton, 1991). Recommendations of this design study are included in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In order to determine the required design of wastewater disposal system, a few factors that act as the treatment facilities and collection system should be looked upon to and taken into considerations. The treatment factors that involved in this design project are:

i) grease tank and

ii) septic tank.

Other treatment facilities that should also taken into considerations are also planting on the leach field and gas-venting system. Meanwhile, for collection system or known as soil absorption system consists of leach field. The hydrological cycle also an important part in the operation of environmental systems. Each of these factors will be discussed separately in the following sections.

2.2 GREASE TANK

Wastewaters from cafeteria normally contain greases, oils and detergents. If the greases and oils can enter the septic tank, there is the possibility that they can be discharged to the soil absorption system. Greases and oils tend to accumulate on the surfaces of the system

ultimately leading to a reduction in the infiltration capacity. Greases and oils are disturbing the soil absorption system because of their persistence.

Grease tank is used to trap greases by cooling and flotation while oils by flotation. The tank serves as a heat exchanger by cooling the liquid that helps to solidify the greases. The grease tank must detain the fluid for an adequate period of time that is more than 30 minutes for flotation to be effective. **Figure 2.1** shows a typical grease tank.

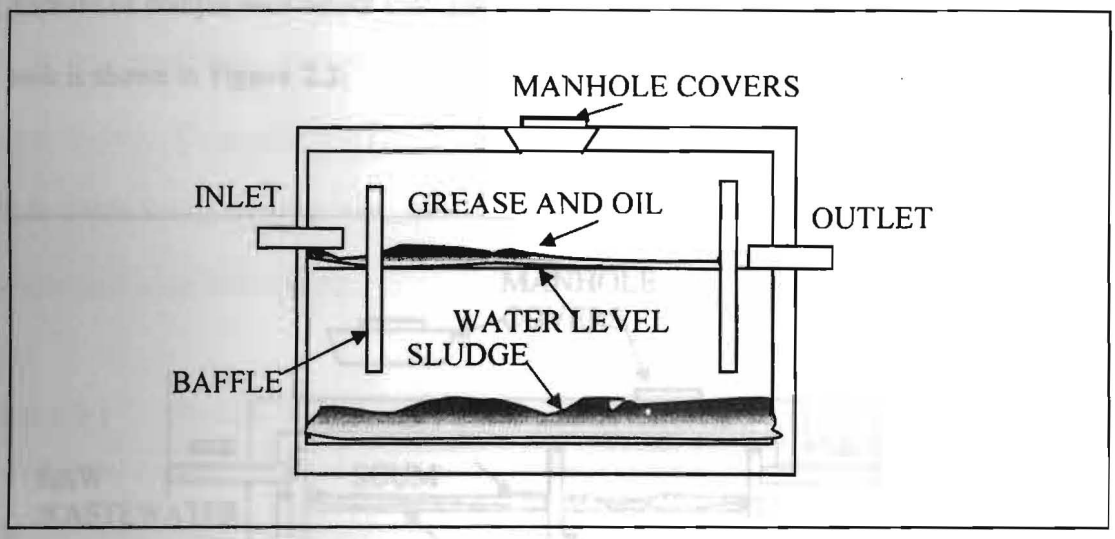


Figure 2.1 Typical grease tank

2.3 SEPTIC TANK

Septic tank is a watertight container which:

i) remove large solids and greases,

ii) provide anaerobic digestions of the solids and

iii) storage of the sludge and scum.

Septic tank must be watertight and structurally sound if it is to function properly. It should be tested for water-tightness and structural integrity by completely filling the tank with water before and after installation. It has to be constructed from durable materials such as concrete or fiberglass that resist excessive corrosion, frost damage and cracking or buckling due to settlement or backfilling. The preferred construction materials of a septic tank are concrete, bricks, clay or fiberglass. For this design, concrete material is preferred because of comparative lower cost and availability of materials locally. A typical septic tank is shown in **Figure 2.2**.

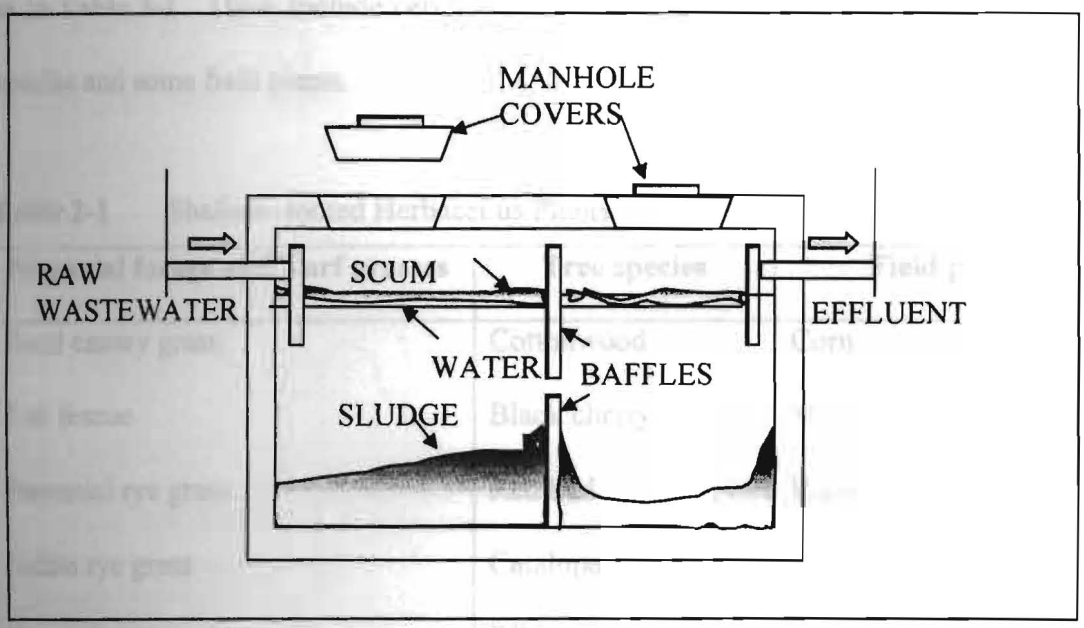


Figure 2.2 Typical septic tank

2.4 PLANT ON LEACH FIELD

The leach field must be located in area where good grass cover is possible. Roots that clog or disrupt the pipes will seriously damage the leach field. An important matter that should be taken into account is to find the suitable plants that would not clog the leach pipes and to meet the landscape needs. This is because plants such as trees and shrubs are much riskier since roots from these plants are more likely to clog and causing the soil absorption system to fail.

Plants that are most suited with leach field system should have few characteristics such as those with high nutrient uptake capacity, high consumptive water use, high tolerance for moist soil conditions, low sensitivity to wastewater constituents and minimum control requirements. Those plants are such as shallow-rooted herbaceous plants and summarized as in **Table 2-1**. These include certain perennial forage grasses, turf grasses, certain tree species and some field plants.

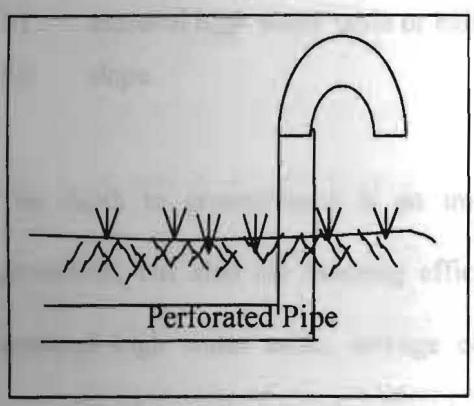
Table 2-1 Shallow–rooted Herbaceous Plants

Perennial forage and Turf grasses	**Tree species**	**Field plants**
Reed canary grass	Cottonwood	Corn
Tall fescue	Black cherry	Milo
Perennial rye grass	Red bud	Barley
Italian rye grass	Catalupa	
Bermuda grass	White pine	
Orchard grass	Green ash	
Brome grass		

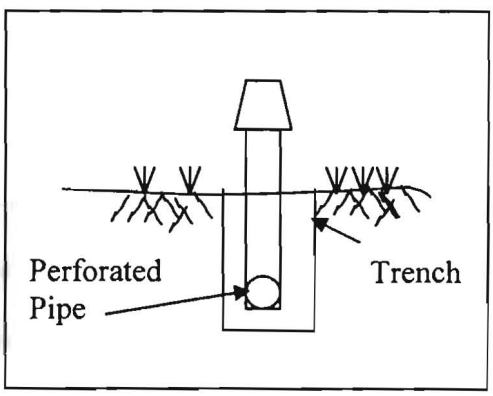
Field plants may be considered when the soil is well drained and the groundwater is below the rooting depth. Shallow-rooted herbaceous plants are unlikely to damage the leach pipes. They help the leach field system to function at its best by removing moisture and nutrients from the soil. The soil conditions are also important to understand before deciding on any landscape planting. Soils vary a great deal in their ability to filter viruses and bacteria.

2.5 GAS-VENTING SYSTEM

The design evaluates the effectiveness of providing ventilation system as an alternative way to prevent the occasional build-up of odorous gases and to allow the odorous gases to be safely vented to the atmosphere, also other possibility factors that may be arise while the system is in progress. There are several types of leach field vents that can be used to vent the gases such as shown below:



(a)



(b)